

UNITED STATES PATENT OFFICE

2,496,676

VACUUM PUMP

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Application November 12, 1946, Serial No. 709,328

6 Claims. (Cl. 230—207)

1

This invention relates to pumps for pumping gases, and more particularly to a pump of the type provided with a muffler which functions also to separate the oil that is carried off by the gas stream flowing through the pump so that the same lubricating oil is available for recirculation. More particularly the invention is concerned with vacuum pumps of the above mentioned character.

Vacuum pumps of the above mentioned character have heretofore been provided with an external muffler on the discharge side of the pump which muffler functions also to remove the oil particles that are carried by the air stream and permit the separated oil to flow back into the pump casing where it is picked up and recirculated to the moving parts of the pump. Such an external muffler not only increases the cost of the pump unit but also is objectionable in that it constitutes a projection that extends from the pump casing and is easily damaged. It is one of the objects of the present invention to provide a pump of the above mentioned character wherein the pump casing contains not only the pumping mechanism but also the muffler and oil separator and the oil circulating means.

It is a further object of the present invention to provide a pump casing which is so constructed that it may be made as a simple casting the interior of which has integrally cast partitions which provide a space for the combination muffler and oil separator.

It is a still further object of the present invention to provide a dividing partition integrally cast with the rest of a pump casing, which partition not only forms the muffler compartment but also forms a web for guiding the movable pumping mechanism, which web is so arranged in relation to the flow of lubricating oil as to facilitate lubrication of the movable parts carried by the web.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is a plan view of a pump embodying the invention;

Figure 2 is a longitudinal cross sectional view, taken along the line 2—2 of Figure 1;

Figure 3 is a right end view of the pump of Figure 1; and

Figure 4 is a fragmentary sectional view taken along the line 4—4 of Figure 2.

2

Referring specifically to the drawings in which like numerals are used to designate like parts, 1 indicates a cast metal pump casing with cooling fins 2 on the exterior surface. The casing is open at opposite sides at one end thereof, the open sides being closed by a pair of plates bolted thereto, as may be seen from Figures 1, 3 and 4. The interior of the casing has a web or partition 3 cast as an integral part of the casing, which partition divides the casing into an inlet compartment 4 in communication with a chamber in which a rotor member is mounted, as hereinafter described, which rotor chamber communicates with successive discharge compartments 4a, 4b and 4c, and thence to the pump outlet, as will be more fully described hereinafter. The compartments 4a, 4b and 4c are in effect one continuous discharge chamber which direct the educated air along a tortuous path. The partition 3 includes a horizontal wall portion 3a, an upper wall portion 3b and a lower vertical wall portion 3c that has an opening 3d therethrough.

The inlet compartment 4 has an inlet opening into which is threaded a combination check valve and connecting nipple 5, having external screw threads 6 on its wall for connection to a system to be evacuated. The check valve includes a ball 7 located within the nipple and normally rests in open position on a rod 8 away from a valve seat 9. When the pump is initially stopped air will tend to flow in a reverse direction through the pump into the vacuum line connected to the nipple 5. The ball 7 will then be lifted to its seat 9 to close the valve to prevent such reverse flow of air through the pump since such reverse flow might tend to operate the pump in the reverse direction. Under normal operating on non-operating conditions the ball is in the position shown.

An eccentric or cam 10 is part of a rotatable drive shaft 11 and actuates a drum-shaped rotor 13. A counterweight 12 is secured to the shaft 11 by a nut 14 and a lock nut 14'. A ball bearing is located between the eccentric and the rotor, this bearing comprising conventional respective inner and outer raceways 15 and 15' with balls 16 interposed therebetween.

The rotating eccentric 10 moves the drum-shaped rotor member 13 in an orbital path with one point of its periphery always in contact with a cylindrical wall 17 forming the rotor or pumping chamber.

A blade 18, flanged at one end to provide a foot 19 for attachment to the rotor member by screws 19a, extends through a slot 20 in the chamber wall 17 and slides in a space 21 between

two bearing members 22 which are free to oscillate in a socket 23 of the web or partition 3. Radial ducts 24 may be provided in the bearings 22 to facilitate lubricating oil flow between the contacting surface of the parts 18, 22 and 23.

The back end of the blade 18 moves in a chamber 26 within the web or partition 3. An opening 27 for reception of the blade 18 is sufficiently oversized to provide clearance for the orbital movement of the blade 18.

A duct 28 in the partition 3 permits the flow of lubricating oil into the chamber 26.

The discharge compartment 4c is provided with a connection 29, such as an elbow, for connection to an exhaust line or for directing the exhaust directly into the atmosphere. A muffler 30, which also acts as an oil trap or filter, is located in the chamber 4c which is formed by the web or partition 3 within the casing. The muffler comprises any material suitable for separating oil from the flowing air stream and may comprise a mass of hair, or steel wool, by way of example, which is held in the chamber 4c by a wire screen strainer 32. A top strainer screen 33 retains the filter material against being blown out by the moving air. The oil which is separated from the air in the muffler flows back into the discharge compartment 4b.

A magnet 34 beneath the filter attracts any free particles of iron that may reach the chamber 4b and thus prevents the circulation of such particles with the circulating lubricating oil. The magnet is on the end of a plug which is screw threaded into a threaded opening in the pump casing. The opening also acts as a drain opening upon removal of the magnet plug. For convenience in casting the pump casing an opening may be provided for supporting the core, which opening is then closed by a threaded plug 35 that fills the opening.

An oil recirculating tube 37 is mounted on and extends through the partition 3. The bottom of the tube is near the bottom of the compartment 4b. The opposite end of the tube has a plug 38 which supports the tube and is in turn threaded into a tapped opening in the partition 3. The plug 38 has a needle-like bore 39 therein which restricts the rate of oil flow therethrough. Oil forced through the tube is ejected as a spray against the underside of a transparent inverted cup 40 the bottom of which fits into a bore 41 in the casing. The cup is detachably held on the casing in any desired manner, as by a snap spring clip 42. The inspection cup may be removed to replenish the oil supply. The angle and location of the bore through which the tube 37 extends is such that it is accessible for machining operations by insertion of a tool through the opening for the cup 40.

In operation of the pump the shaft 11 rotates counterclockwise as seen in Figure 2, causing the rotor 13 to move in a circular path constantly in contact with the cylinder bore 17. The blade 18 makes a sliding seal at the bearing members 22 and together with the rotor 13 and the partition 3 separates the inlet compartment 4 from the outlet compartments. The rotor action draws air from the intake and forces it through the discharge compartments 4a, 4b and 4c and out to the atmosphere through the muffler exhaust 29. The air moving through the rotor compartment draws with it some of the lubricating oil within the pump. The quantity of lubricating oil initially placed within the casing is sufficiently large so that the oil carried by the air moves through

the compartment 4a as a thick mist. This mist is collected in the muffler and drains back into the compartment 4b. At the same time the preponderance of pressure in the compartment 4b over the pressure in the vacuum compartment 4 forces oil to flow up the tube 37 and through the choke 39 where it is emitted as a stream of oil which impinges upon the sight glass or cup 40 and then drops down on the top of the web or partition 3. Some of the oil then flows through the duct 28 into the chamber 26 and is effective to lubricate the opposite surfaces of the blade 18 and also to lubricate the contacting surfaces between the bearing 22 and the web or partition 3. The rest of the oil drops onto the top of the blade 18 where it is picked up by the air stream and serves to lubricate the outer surface of the rotor 13 and the cylindrical wall 17.

As the air which carries with it the oil mist is educted through the pumping chamber it first passes through the restricted slot 20 and enters the large discharge compartment 4a. There its velocity is considerably reduced over the velocity of the air initially leaving the pumping chamber, due to the larger cross sectional area of the compartment 4a. The air traveling through the compartment 4a leaves that compartment via the small opening 3d in the wall portion 3c. In the compartment 4b the velocity of the air again changes over what it was through the restricted throat portion or opening 3d. The existence of the wall 3c with the opening 3d therein dividing the space into compartments 4a and 4b serves to muffle the noises of the air educted through the pump. The wall 3c produces changes in the direction of the flowing air and thus tends to cause some of the oil that is carried by the moving mass of air to precipitate out. Likewise the air flowing from the compartment 4b to the compartment 4c has a substantial change in direction which further tends to separate out oil particles from the air stream. Furthermore, oil that is separated from the air stream as the air stream moves through the muffler or filter material 30 flows downwardly through the strainer 32 with the direction of the downward oil flow at a substantial angle to the direction of the air flow into and below the strainer 32. Therefore air moving upwardly through the strainer has a smaller tendency to inhibit the downward flow of separated oil through the strainer than would be the case if the air and oil were moving in exactly opposite directions.

From the above description it is apparent that by the present invention there is provided a vacuum pump having a contained lubricating system and a contained muffler and oil trap. By locating the muffler within the pump casing the applicant not only eliminates the expense of an external muffler, but also eliminates the likelihood of damage to an externally extending muffler. The applicant also eliminates thereby the possibility of air leakage to the atmosphere from the joints between the muffler and the pump casing, such as was present in the prior vacuum pumps having external mufflers.

In compliance with the requirements of the patent statutes I have here shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise construction here shown, the same being merely illustrative of the principles of the invention. What I consider new and desire to secure by Letters Patent is:

1. A gas pump comprising a casing having in-

let and discharge openings, a web or partition wall in the casing between the openings and dividing the casing into inlet and discharge compartments, a filter mounted within the casing on the web or partition wall in one of said compartments, an open ended oiling tube attached to the web or partition and having one end disposed beneath the filter and adjacent the bottom of the compartment housing the filter, and the opposite end of the tube disposed in the inlet compartment, and a removable cap member in the top of the casing adjacent to and in line with the end of the tube which is in the inlet compartment.

2. A gas flow device including a casing having means forming a pumping chamber at one end thereof, mechanically operable gas flow means in said chamber, a partition within the casing and constituting an integral part of the casing and together with the gas flow means dividing the casing into an intake compartment and a discharge compartment both communicating with the pumping chamber, an open ended lubrication tube extending through the partition to adjacent the bottom of the discharge compartment and establishing communication between the intake and discharge compartments for supplying lubricant for said mechanical gas flow means, said casing having an opening above the top of the tube, a closure for the opening, the tube directing flowing oil against said closure, said integral partition further subdividing the discharge compartment to provide a muffler chamber at the outlet end of the discharge compartment, the discharge compartment having in addition a baffle wall across the same forming a constriction therein to increase the muffling and oil separating action as an oil and gas mixture moves through the discharge chamber, said baffle being an integral part of the casing.

3. A gas flow device including a casing having means forming a pumping chamber at one end thereof, mechanically operable gas flow means in said chamber, a partition within the casing and constituting an integral part of the casing and together with the gas flow means dividing the casing into an intake compartment and a discharge compartment both communicating with the pumping chamber, the casing having sight glass opening at the intake compartment thereof, a sight glass closing said opening, a lubrication tube extending through the partition and establishing communication between the intake and discharge compartments, the tube being in line with the sight glass opening so that it is insertable into and removable from position by a movement through the opening and directs the fluid flowing therethrough towards the sight glass and into the gas stream in the intake compartment for lubricating said mechanical gas flow means, said integral partition further subdividing the discharge compartment to provide a muffler chamber at the outlet end of the discharge compartment, the discharge compartment having in addition a baffle wall across the same forming a constriction therein to increase the muffling and oil separating action as an oil and gas mixture moves through the discharge chamber, said baffle being an integral part of the casing.

4. An air pump including a casing having means forming a pumping chamber at one end thereof, rotary air pumping means in said chamber, a partition within the casing and constituting an integral part of the casing and together with the pumping means dividing the casing into an intake compartment and a discharge com-

partment both communicating with the pumping chamber, the casing having a sight glass opening at the intake compartment thereof, a sight glass closing said opening, an open ended lubrication tube extending through the partition to adjacent the bottom of the discharge compartment and establishing communication between the intake and discharge compartments, the tube being in line with the sight glass opening so that it is insertable into and removable from position by a movement through the opening and directs the fluid flowing therethrough towards the sight glass and into the gas stream in the intake compartment for lubricating said pumping means, said integral partition further subdividing the discharge compartment to provide a muffler chamber at an end of the discharge compartment, the discharge compartment having in addition a baffle wall across the same forming a constriction therein to increase the muffling and oil separating action as an oil and air mixture moves through the discharge chamber, said baffle being an integral part of the casing.

5. A gas flow device including a casing having means forming a pumping chamber at one end thereof, mechanically operable gas flow means in said chamber, a partition within the casing, said partition together with the gas flow means dividing the casing into an intake compartment and a discharge compartment both communicating with the pumping chamber, the casing having a sight glass opening at the intake compartment thereof, a sight glass closing said opening, and a lubrication tube extending through the partition and establishing communication between the intake and discharge compartments, the tube discharging into the region of the sight glass opening.

6. A gas flow device including a casing having means forming a pumping chamber at one end thereof, mechanically operated gas flow means in said chamber, a partition within the casing, said partition together with the gas flow means dividing the casing into an intake compartment and a discharge compartment both communicating with the pumping chamber, the casing having a sight glass opening at the intake compartment thereof, a sight glass closing said opening, a lubricating tube extending through the partition and establishing communication between the intake and the discharge compartments, the end of the tube being in the region of the sight glass opening and the tube being insertable into and removable from position by a movement through the opening, said tube directing the lubricant flowing therethrough towards the sight glass opening, said lubricant then moving into the gas stream in the intake compartment for lubricating said mechanical gas flow means.

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